WHAT IS CLAIMED IS:

1. A core for casting a metal part, comprising:

a body having solid portions spaced apart by hollow portions; and

at least one support element extending between adjacent solid portions, the at least one support element having a shape optimized to prevent the core from fracturing during a casting process and to minimize operating mechanical stress in the area of the metal part formed by the support element.

2. The core of claim 1, wherein the at least one support element comprises:

a cross section having a first radius, a second radius, a third radius, a fourth radius, and a fifth radius, each radius defined by a center point and a circumferential arc;

a first distance defining a length between the center point of the first radius and the center point of the second radius; and

a second distance defining a length between the center point of the second radius and the center point of the third radius.

3. The core of claim 2, wherein the first and third radii are substantially equal in length.

4. The core of claim 2, wherein the forth and fifth radii are substantially equal in length.

5. The core of claim 2, wherein the first distance is substantially equal to the second distance.

6. The core of claim 2, wherein the center point of the fourth radius is positioned such that the circumferential arc of the fourth radius is simultaneously tangent to the circumferential arcs of the first, second, and third radii.

7. The core of claim 2, wherein the center point of the fifth radius is positioned such that the circumferential arc of the fifth radius is simultaneously tangent to the circumferential arcs of the first, second, and third radii.

8. The core of claim 2, wherein the circumferential arcs of the fourth and fifth radii define opposing sides of the core cross-section.

9. The core of claim 2, wherein each circumferential arc is defined by a higher order curve that approximates a radius.

10. The core of claim 9, wherein the higher order curve is a spline.

11. The core of claim 9, wherein the higher order curve is a B-spline.

12. The core of claim 1, wherein the metal part is a moving part.

13. The core of claim 12, wherein the moving part is a turbine blade.

14. The core of claim 1, wherein the metal part is a stationary part.

15. The core of claim 12, wherein the stationary part is a turbine vane.

16. The core of claim 1, wherein the core is made from ceramic composite material.

17. A method for designing a core comprising the steps of:

defining a first radius with a center point and a circumferential arc;

defining a second radius with a center point and a circumferential arc;

positioning the second center point a first distance from the first center point;

defining a third radius with a center point and a circumferential arc;

positioning the third radius a second distance from the second radius;

defining a fourth radius having a center point and a circumferential arc, the circumferential arc being positioned tangent to the circumferential arcs of the first, second, and third radii; and

defining a fifth radius having the circumferential arc positioned tangent to the circumference of the first, second, and third radii.

18. The method of claim 17, wherein the first and second radii are substantially equal in length.

19. The method of claim 17, wherein the fourth and fifth radii are substantially equal in length.

20. The method of claim 17, wherein the center points of the fourth and fifth radii are positioned on opposite sides from one another.

21. The method of claim 17, wherein the first and second distances are substantially equal in length.

22. The method of claim 17, wherein each circumferential arc is defined by a higher order curve that approximates a radius.

23. The method of claim 22, wherein the higher order curve is a spline.

24. The method of claim 22, wherein the higher order curve is a B-spline.

25. A method for manufacturing a core for casting a metal part comprising the steps of:

providing ceramic slurry;

injecting the slurry into a core die to form a green core with solid portions spaced apart by a corresponding hollow portion; and

forming at least one support element between adjacent solid core portions, the at least one support element having a shape optimized to prevent the core from fracturing during a casting process and to minimize operating mechanical stress in the area of the metal part formed by the support element.

26. The method of claim 25, further comprising the steps of:

removing the core from the die;

drying the core; and

heating the core at a predetermined temperature to increase material strength.

27. The method of claim 25 further comprising the steps of:

treating the surface of the core to increase strength of the core; and

machining the core to meet specification dimensions.

28. The method of claim 25, wherein a cross section of the at least one support element formed comprising the steps of:

defining a first radius;

defining a second radius a first distance from the first radius;

defining a third radius a second distance from the second radius;

defining a fourth radius having a circumference positioned tangent to the circumference of the first, second, and third radii; and

defining a fifth radius having the circumference positioned tangent to the circumference of the first, second, and third radii.

29. The method of claim 28, wherein the first and second radii are substantially equal in length.

30. The method of claim 28, wherein the forth and fifth radii are substantially equal in length.

31. The method of claim 28, wherein the first and second distances are substantially equal in length.

32. The method of claim 28, wherein the forth and fifth radii are positioned on opposite sides of the support cross-section.

33. A method for forming a cast part comprising the steps of:

forming a ceramic core with at least one support element extending between adjacent solid portions spaced apart by a corresponding hollow section, the at least one support element having a shape optimized to prevent the core from fracturing during a casting process and to minimize operating mechanical stress in the area of the metal part formed by the support element;

making a wax die to define external geometry of the cast part;

injecting wax into the wax die to form a wax pattern of the cast part;

inserting the ceramic core into the wax pattern;

injecting ceramic slurry into the wax pattern to form a mold shell;

drying the mold shell;

removing the wax from the mold;

heating the mold to a predetermined temperature to increase the strength of the ceramic mold;

cooling the mold to a predetermined temperature;

preheating the mold to melting temperature of the casting material;

pouring molten casting material into the mold;

cooling the mold in a controlled environment;

removing the casting mold shell from the cast part;

leeching the core from the cast part;

inspecting the part with N-ray to verify that the entire core has been removed;

etching the surface of the cast part;

laue'ding and inspecting the grain structure of the cast part;

inspecting the surface of the cast part with fluorescent penetrate;

inspecting internal features of the cast part with X-ray;

finish machining the external features of the cast part;

inspecting the external dimensions of the cast part; and

flow testing the internal passages of the cast part.

34. The method of claim 33, wherein a cross section of the at least one support element formed comprising the steps of:

defining a first radius;

defining a second radius a first distance from the first radius;

defining a third radius a second distance from the second radius;

defining a fourth radius having a circumference positioned tangent to the circumference of the first, second, and third radii; and

defining a fifth radius having the circumference positioned tangent to the circumference of the first, second, and third radii.

35. The method of claim 33, wherein the first and second radii are substantially equal in length.

36. The method of claim 33, wherein the forth and fifth radii are substantially equal in length.

37. The method of claim 33, wherein the first and second distances are substantially equal in length.

38. The method of claim 33, wherein the forth and fifth radii are positioned on opposite sides of the support cross-section.

39. A turbine blade manufactured according to the method of claim 33, comprising:

an airfoil having solid portions with at least one through aperture formed therein by a casting core, the at least one aperture having a shape optimized to minimize operating mechanical stress in a localized area around the aperture.

40. The turbine blade of claim 39, wherein the at least one aperture comprises:

a cross section having a first radius, a second radius, a third radius, a fourth radius, and a fifth radius, each radius defined by a center point and a circumferential arc;

a first distance defining a length between the center point of the first radius and the center point of the second radius; and

a second distance defining a length between the center point of the second radius and the center point of the third radius.

41. The turbine blade of claim 40, wherein the first and third radii are substantially equal in length.

42. The turbine blade of claim 40, wherein the forth and fifth radii are substantially equal in length.

43. The turbine blade of claim 40, wherein the first distance is substantially equal to the second distance.

44. The turbine blade of claim 40, wherein the center point of the fourth radius is positioned such that the circumferential arc of the fourth radius is simultaneously tangent to the circumferential arcs of the first, second, and third radii.

45. The turbine blade of claim 40, wherein the center point of the fifth radius is positioned such that the circumferential arc of the fifth radius is simultaneously tangent to the circumferential arcs of the first, second, and third radii.

46. The turbine blade of claim 40, wherein the circumferential arcs of the fourth and fifth radii define opposing sides of the core cross-section.

47. The turbine blade of claim 40, wherein each circumferential arc is defined by a higher order curve that approximates a radius.

48. The turbine blade of claim 47, wherein the higher order curve is a spline.

49. The turbine blade of claim 47, wherein the higher order curve is a B-spline.

50. The core of claim 39, wherein the core is made from ceramic composite material.

51. A cast metal part formed from a casting core, comprising:

a body having solid portions spaced apart by hollow portions; and

at least one support element extending between adjacent solid portions; and

a cross section of the support element defined by at least three radii having a center point and a circumferential arc, and a pair of opposing curves formed tangent to the circumferential arcs of the three radii.

52. The part of claim 51, wherein the cross section further comprises:

a first distance separating the center points of the first and second radii; and

a second distance separating the center points of the second and third radii

53. The part of claim 51, wherein the first and third radii are substantially equal in length.

54. The part of claim 51, wherein the pair of curves are circular.

55. The part of claim 54, wherein the radius of each curve is equal in length.

56. The part of claim 51, wherein the pair of curves are higher order.

57. The part of claim 56, wherein the higher order curve is a spline.

58. The part of claim 56, wherein the higher order curve is a B-spline.

59. The part of claim 51, wherein the first distance is substantially equal to the second distance.